REMARKS

Applicant respectfully requests reconsideration of this application as amended. Claims 1-3, 5-11, 13-16, 18-21, 23-27, 30-46, 49-53, 56-60, 62-67, 69-72, and 74-75 remain in this application. Claims 1, 7, 14, 18, 24, 31, 33-37, 39-43, 50, 57, 64, and 71 have been amended. Claims 12, 28, 29, 47, 48, 54, and 55 have been canceled. No new claims have been added.

Claim Objections

The Examiner objected to claim 75 as containing informalities. Applicant respectfully submits that claim 75, as amended, overcomes the objection.

Rejections under 35 U.S.C. § 103(a)

The Office Action rejected claims 1-3 and 5-6 under 35 U.S.C. § 103(a) as being unpatentable over Golmie et al., "A Differentiated Optical Services Model for WDM Networks" (hereinafter "Golmie") in view of Assi et al., "Optical Networking and Real-Time Provisioning: An integrated Vision for the Next-Generation Internet" (hereinafter "Assi") and Kodialam et al., US Patent Application Publication No. 2002/0018264 A1 (hereinafter "Kodialam").

Golmie describes "a QoS service model in the optical domain … based on a set of optical parameters that captures the quality and reliability of the optical lightpath." (Golmie, Abstract and Table 1.) An optical lightpath being "an optical communication channel, traversing one or more optical links, between a source-destination pair." (Golmie, Page 69, Left column.) Golmie classifies lightpaths (not wavelengths or paths) based on QoS and these classes for example "consist[] of three alternate lightpaths between a single source-destination pair accessible at the WADM, each with a unique DoS class, labeled class 1, class 2, and class 3, containing wavelength groups (λ_1, λ_2), (λ_3,

λ_4), and (λ_5, λ_6) respectively… All lightpaths in a DoS class have equivalent quality of optical service between a source-destination pair." (Golmie, page 72, Left column.) Golmie does not describe determining service level topologies. (See Office Action, page 3.)

Assi describes path allocation using two dynamic algorithms to help with the so-called "routing and wavelength assignment (RWA) problem." (Assi, page 38, right column.) In both algorithms, a network with multiple nodes/OXCs (without wavelength conversion) is interconnected and "all nodes maintain a synchronized and identical topology and link state information (traffic engineering database, TED)." (Assi, page 39, right column.) Assi describes using OSPF to provide the network topology (Assi, page 43, left column). "[T]he network is represented by W identical graphs, each conforming to the physical topology and a particular wavelength." (Assi, page 40, left column.) "For a given connection request, a constraint route is calculated, for each of the wavelength graphs, throughout the entire network from source to destination, typically using a shortest path algorithm but with link weights adjusted to attain some sort of local resource optimization." (Assi, page 40, left column.) Accordingly, each node of the network has the same physical topology database for the network. These nodes do not store what paths or wavelengths are available from a given node's perspective. Rather, in response to a connection request, all of the different paths from a source node to a destination node are calculated on the fly and the best path chosen from the calculated paths.

Kodialam describes path allocation using "dynamic routing (IDR) of service level (e.g., bandwidth) guaranteed paths for network tunnel paths…" (Kodialam, Abstract.) "IDR determines whether to route an arriving request for a network tunnel path over the existing topology or to open a new, available optical wavelength path." (Kodialam, Abstract.) "[E]ach LSP [label switched path] determined route is computed at the local ingress router without communication with a domain or area wide router-server in

communication with all routers of the nodes in the network….In employing OSPF and its extension, the topology information may be derived from the link sate database, with residual capacities derived using messaging and signaling methods…" (Kodialam, Paragraph 0041.) The network of Kodialam may have OXCs with or without wavelength conversion capability. (Kodialam, Paragraphs 0045-0046.) Kodialam discloses layering a logical internet protocol (IP) network over the physical optical network.

Holender discloses establishing a set of logical networks on top of a physical electrically switched network, such as Asynchronous Transfer Mode (ATM) networks (Holender, col. 5, lines 43-48). Each logical network is logically separated from the other logical networks. (Holender, Col. 3, lines 61-67).

Thus, the combination of Golmie, Kodialam, Holender, and Assi is a QoS service model in the optical domain based on a set of optical parameters that captures the quality and reliability of an optical <u>lightpath</u> (not paths and wavelengths individually) and uses <u>OSPF to determine the physical network topology for the entire system which is stored in each node of the network</u>. In this model, <u>each node has the same database</u> that contains <u>information about the all of the nodes of entire network</u> and is not specific to just that particular node. This database information would include information about lightpaths separated by class for the entire network and would not be specific to a particular access node.

Thus, this combination does not describe claim 1, as amended:

A method comprising:
creating a plurality of separate service levels by applying a set of one or more connectivity constraints that include quality of service (QoS) based criteria on a physical network topology of a wave length division multiplexing optical network to divide said optical network into said plurality of separate service levels, wherein the connectivity constraints are based on a conversion criteria;
determining service level topologies for each of said plurality of separate service levels for each of a plurality of access nodes in the optical network, wherein each service level topology is a network topology smaller than the

physical network topology and said each service level topology comprises end to end paths satisfying the corresponding service level from that access node to all other reachable access nodes in said optical network as destinations, wherein an end to end path between two access nodes is the set of one or more links and available wavelengths on that end to end path between the two access nodes, wherein allocated and unallocated wavelengths are considered available wavelengths; and

storing the plurality of service level topologies in a service level connectivity database for each access node and on that access node, wherein the service level connectivity database includes a service level topology structure for each of the plurality of service level topologies and each service level topology structure references the end to end paths for that access node satisfying the corresponding service level, wherein each of the set of end to end paths for that service level references a set of links satisfying that service level on that possible end to end path, wherein the set of links references available wavelengths for that possible end to end path satisfying that service level.

(Claim 1, as amended) As stated in the Office Action, the Examiner admits that Golmie does not teach or suggest determining service level topologies. (Office Action, Page 2.) Holender discloses simply describes partitioning an electrically switched network into logical networks but not service level topologies. Thus, neither Golmie nor Holender do not teach or suggest "storing the plurality of service level topologies in a service level connectivity database for each access node and on that access node, wherein the service level connectivity database includes a service level topology structure for each of the plurality of service level topologies and each service level topology structure references the end to end paths for that access node satisfying the corresponding service level."

In addition, both Kodialam and Assi disclose using OSPF to provide topology information. As is known in the art, nodes using OSPF have the same link-state database for every known node in the network (See, e.g., Moy, "OSPF Version 2", RFC-2328, pp. 18-21; and Applicant's specification, paragraph 16). A node generates a shortest path first tree (SPF) representing paths from the source node to other destinations that is used to allocate a path (Moy, p. 21-23). However, the link-state database and SPF tree are not

partitioned into separate databases and/or structures based on service level. Thus, because Kodialam and Assi rely on OSPF for the underlying network topology, neither reference teaches or suggests "storing the plurality of service level topologies in a service level connectivity database for each access node and on that access node, wherein the service level connectivity database includes a service level topology structure for each of the plurality of service level topologies and each service level topology structure references the end to end paths for that access node satisfying the corresponding service level."

In addition, storing service level topology structures that reference a set of end to end paths satisfying the corresponding service level is not obvious to one of skill in the art. In order to support an obvious rejection, the Examiner must show that the difference between the prior art cited and the claimed invention would have been obvious to one of skill in the art (Fed. Reg. Vol. 72, No. 195, p. 57528). One example of one of skill in the art can be found in the well-known OSPF protocol. As described above, OSPF databases and SPF tress that are not portioned into separate structures based on service level. It should be noted that the since OSPF is a protocol typically used in optically networking to create topology databases, Moy would be considered one of skill in the art. Furthermore, even though it may have known at the time of Moy that a database may be organized in a different fashion, Moy (and others who use OSPF) chose to organize the topology database as a link/lambda state database and/or a link/lambda SPF tree, instead of a topology database with partitioned based on service level. Thus, because Moy organized the OSPF database(s) differently than Applicant's topology database and Moy is one of skill in the art, it would not have been obvious to one of skill in the art to try to store separate service level topology structures that reference a set of end to end paths satisfying the corresponding service level.

Furthermore, the Examiner cites the Applicant's specification as support that a smaller service level topology is known in the prior art (Office Action, page 20). In support of this argument, the Examiner's cite page 10, last paragraph of the Applicant's

specification: "As a result of the set of connectivity constraints, such network topology databases are smaller in comparison to network topology databases that represent all physical connectivity in the network." Applicant respectively submits this quote is part of Applicant's Detailed Description that beings on page 9 and not part of Applicant's Background. As such, <u>this cite is not an admission that a smaller service topology is known in the prior art</u>. Furthermore, Applicant states in the background that adding quality of service type information makes a network topology database larger, not smaller (Specification, paragraph 17).

The above quoted limitations are not described or suggested by Golmie, Kodialam, Assi, or Holender. While there are various uses for the invention as claimed, several such uses are discussed in Figure 4 and paragraphs 71-72. Thus, while the invention is not limited to the uses discussed on these pages, it should be understood that Golmie, Kodialam, Assi, and/or does not enable these uses and the above quoted limitations do.

Accordingly, the combination of Golmie, Kodialam, Assi, and Holender does not describe what Applicants' claim 1 requires. Claims 2-3 and 5-6 are dependent upon claim 1 and are therefore allowable for at least the same reason.

The Office Action rejected claims 7-9 under 35 U.S.C. § 103(a) as being unpatentable over Golmie in view of Kodialam and Holender. The combination of Golmie and Kodialam does not describe what Applicants are claiming.

Thus, the combination of Golmie, Holender, and Kodialam is a QoS service model in the optical domain based on a set of optical parameters that captures the quality and reliability of an optical <u>lightpath</u> (not paths and wavelengths individually) and uses <u>OSPF-TE to determine physical network topologies for the entire system</u>. As per above, none of Golmie, Kodialam or Holender teach or suggest storing service level topology structures that reference a set of end to end paths satisfying the corresponding service

level. However, claim 7 requires "updating the plurality of maintained service level topologies in a service level database for each node and on that node, wherein the service level connectivity database includes a service level topology structure for each of the plurality of service level topologies and each service level topology structure references a set of end to end paths satisfying the corresponding service level."

Accordingly, the combination of Golmie, Holender, and Kodialam does not describe what Applicants require in claim 7. Claims 8-9 are dependent upon claim 7 and are therefore allowable for at least the same reason.

The Office Action rejected claims 14-16 under 35 U.S.C. § 103(a) as being unpatentable over Golmie in view of Assi, Kodialam and Holender.

Thus, the combination of Golmie, Kodialam, Assi, and Holender is a QoS service model in the optical domain based on a set of optical parameters that captures the quality and reliability of an optical lightpath (not paths and wavelengths individually) and uses OSPF-TE to determine the physical network topology for the entire system which is stored in each node of the network. In this model, each node has the same database that contains information about the all of the nodes of entire network and uses a SPF tree to allocate paths and the OSPF database is not separated into different databases based on path service level.

The Examiner asserts in the Office Action that "it is obvious that in order to setup lightpaths for various service levels, it is necessary to have separate network topology databases in the WDM network." The Examiner cites Assi as supporting this argument. However, as per above Assi discloses using OSPF to supply the network topology information. OSPF is well-known in the art to uses a single monolithic database that is not separated based on path service level. Thus, it is not obvious or necessary to have separate network topology databases in the WDM network. Therefore, none of Golmie,

Kodialam, Assi, or Holender teaches or suggests a plurality of separate topology databases for each of the service levels of paths on an access node.

For example, claim 14 requires, "at least one separate network topology database for each of said plurality of service levels that represents end to end paths between access nodes of said optical network using those of the wavelengths that qualify for that service level, wherein each access node of said optical network stores a separate one of said network topology databases for each of said plurality of service levels."

Accordingly, the combination of Golmie, Kodialam, and Assi does not describe what Applicants' claim 14 requires. Claims 15-16 are dependent upon claim 14 and are therefore allowable for at least the same reason.

The Office Action rejected claims 18-21, 24-25, 31-32, 34, 43-47, and 49 under 35 U.S.C. § 103(a) as being unpatentable over Golmie in view of Assi, Kodialam, and Holender.

The combination of Golmie, Kodialam, Assi, and Holender is a QoS service model in the optical domain based on a set of optical parameters that captures the quality and reliability of an optical lightpath (not paths and wavelengths individually) and uses OSPF-TE to determine the physical network topology for the entire system which is stored in each node of the network. In this model, each node has the same database that contains information about the all of the nodes of entire network and uses a SPF tree to allocate paths and the OSPF database is not separated into different databases based on path service level. However, as per above, the combination does not teach or suggest each access node storing a plurality of separate topology structures for each of the service levels of paths on an access node.

The combination does not describe what Applicants' claims 18, 24, 31, and 43 require. For example, claim 18, as amended, requires "for each access node of said optical network, a service level topology structure based on a conversion criteria for each

of said plurality of service levels representing end to end paths of that access node to all other access nodes using wavelengths from the link service level channel sets of that service level, wherein each access node stores those of said service level topology structures, and wherein said topology structures is smaller than a physical network topology of said optical network."

Furthermore, claim 24, as amended, requires "a service level connectivity database to store, for each of said set of service levels, a service level topology structure based on a conversion criteria that stores a representation of the service level topology of that service level for said access node, wherein the service level topology is smaller than a physical network topology of said optical network, and wherein each of the service level topology structure references a set of end to end paths satisfying the corresponding service level, wherein each end to end path wherein an end to end path between two access nodes is the set of one or more links and available wavelengths on that end to end path between the two access nodes, wherein allocated and unallocated wavelengths are considered available wavelengths, wherein each of the set of end to end paths for that service level references a set of links satisfying that service level on that possible end to end path, wherein the set of links references available wavelengths for that possible end to end path satisfying that service level."

In addition, claim 31, as amended, requires "for each of said plurality of service levels, instantiate a service level topology structure based on a conversion criteria, wherein each service level topology is a network topology smaller than the physical network topology, and wherein the service level topology structure references a set of end to end paths satisfying the corresponding service level."

Claim 43, as amended, requires "establishing a plurality of different service level topologies for a source node of an wavelength division multiplexing optical network in separate service level topology structures, wherein each of the plurality of different service level topologies references a set of communication paths satisfying the

corresponding service level … selecting one of the communication paths and a wavelength on that path using a database that stores, for each of the plurality of service levels, the separate service level topology structures."

Accordingly, the combination of Golmie, Assi, Kodialam, and Holender does not describe what Applicants require in claims 18, 24, 31, and 43. Claims 19-23, 25-30, 32-36, 44-47, and 49 are dependent upon claim 18, 24, and 31 are therefore allowable for at least the same reason.

The Office Action rejected claims 37-38, 40, 50-53, 56, and 71-73 under 35 U.S.C. § 103(a) as being unpatentable over Golmie, Assi, Holender, and Kodialam as applied to claims 18-20, 22, 24-25, 31-32, and 34, and further in view of Freeman, "Telecommunication System Engineering" (hereinafter "Freeman"). Freeman describes to store method steps as program memory for providing instructions to a controller or computer.

The combination of Golmie, Kodialam, Assi, Holender, and Freeman is a QoS service model in the optical domain based on a set of optical parameters that captures the quality and reliability of an optical lightpath (not paths and wavelengths individually) and uses OSPF-TE to determine the physical network topology for the entire system which is stored in each node of the network. In this model, each node has the same database that contains information about the all of the nodes of entire network and uses a SPF tree to allocate paths and the OSPF database is not separated into different databases based on path service level. However, as per above, the combination does not teach or suggest each access node storing a plurality of separate topology structures for each of the service levels of paths on an access node.

The combination does not describe what Applicants' claims 37, 50, and 71 require. For example, claim 37, as amended, requires "…for each of said plurality of service levels, instantiate a service level topology structure, based on a conversion criteria

wherein each service level topology is a network topology smaller than the physical network topology, and wherein the service level topology structure references a set of end to end paths satisfying the corresponding service level …"

Furthermore, claim 50, as amended, requires "establishing a plurality of different service level topologies for a source node of an wavelength division multiplexing optical network in separate service level topology structures, wherein each of the plurality of different service level topology references a set of communication paths satisfying the corresponding service level … selecting one of the communication paths and a wavelength on that path using a database that stores, for each of the plurality of service levels, the separate service level topology structures."

In addition, claim 71, as amended, requires "a service level connectivity database for an access node of a wave division multiplexing optical network, wherein each link of said optical network includes a set of zero or more lamdas for each of a plurality of service levels, each of said plurality of service levels includes a set of zero of more possible end to end paths comprised of a series of one or more links that include one or more available lamdas of that service level, wherein allocated and unallocated lambda are considered available lambdas, wherein the service level connectivity database includes a separate service level topology structure for each of said plurality of service levels, wherein said separate service topology structure is smaller than a physical network topology of said optical network, said separate service topology structure is based on a conversion criteria, each of said plurality of service level topology structures storing the data for each of the possible end to end paths of that service level that end with said access node …"

Accordingly, the combination of Golmie, Assi, Kodialam, and Freeman does not describe what Applicants require in claims 37 and 50. Claims 38-42, 51-53, 55-56, and 72-73 are dependent upon claims 37 and 50 and are therefore allowable for at least the same reason.

The Office Action rejected claims 30, 57-60, and 62-63 under 35 U.S.C. § 103(a) as being unpatentable over Golmie, Assi, and Kodialam in view of Melaku et al., US Patent Publication No. 2003/0074443 (hereinafter "Melaku").

Melaku describes rerouting traffic to a different path based on a change in QoS requirements. (Melaku, Paragraph 0056.) "If the user decides to change QoS requirements in the midst of a session, the LMQB [Last Mile QoS Broker] dynamically updates the database [of the LMQB] and re-allocates new resources and establishes a path that meets the requested quality of service." (Melaku, Paragraph 0056.)

The combination of Golmie, Kodialam, Assi, and Melaku is a QoS service model in the optical domain based on a set of optical parameters that captures the quality and reliability of an optical <u>lightpath</u> (not paths and wavelengths individually) and <u>uses OSPF-TE to determine the physical network topology for the entire system which is stored in each node of the network.</u> In this model, each node has the same database that contains information about the all of the nodes of entire network and uses a SPF tree to allocate paths and the OSPF database is not separated into different databases based on path service level. Additionally, this common database may be updated dynamically in each node to reflect QoS changes (each node will note the QoS changes). However, as per above, the combination does not teach or suggest each access node storing a plurality of separate topology structures for each of the service levels of paths on an access node.

The combination of Golmie, Assi, Kodialam, and Melaku does not describe what Applicants require in claim 57. For example, claim 57, as amended, requires "<u>establishing different service level topologies for a source node of an wavelength division multiplexing optical network in separate service level topology structures,</u>

wherein each separate service level topology references a set of communication paths satisfying the corresponding service level … selecting one of the communication paths and a wavelength on that path using a database that stores, for each of the plurality of service levels, the separate service level topology structures".

Accordingly, the combination of Golmie, Assi, Kodialam, Holender, and Melaku does not describe what Applicants require in claim 57. Claims 58-60 and 62-63 are dependent upon claim 57 and are therefore allowable for at least the same reason.

The Office Action rejected claims 64-67 and 69-70 under 35 U.S.C. § 103(a) as being unpatentable over Golmie, Assi, Kodialam, Holender, and Freeman in view of Melaku as applied to claims 57-60, and further in view of Freeman.

The combination of Golmie, Kodialam, Assi, Freeman, Holender, and Melaku is a QoS service model in the optical domain based on a set of optical parameters that captures the quality and reliability of an optical lightpath (not paths and wavelengths individually) and uses OSPF-TE to determine the physical network topology for the entire system which is stored in each node of the network. In this model, each node has the same database that contains information about the all of the nodes of entire network and uses a SPF tree to allocate paths and the OSPF database is not separated into different databases based on path service level. Additionally, this common database may be updated dynamically in each node to reflect QoS changes (each node will note the QoS changes). However, as per above, the combination does not teach or suggest each access node storing a plurality of separate topology structures for each of the service levels of paths on an access node.

The combination of Golmie, Kodialam, Assi, Freeman, Holender, and Melaku does not describe what Applicants require in claim 64. For example, claim 64, as amended, requires "establishing different service level topologies for a source node of an

wavelength division multiplexing optical network in separate service level topology structures, wherein each separate service level topology references a set of communication paths satisfying the corresponding service level … selecting a path and a wavelength on said path using a database that stores, the separate service level topology structures …"

Accordingly, the combination of Golmie, Assi, Kodialam, Freeman and Melaku does not describe what Applicants require in claim 64. Claims 65-67 and 69-70 are dependent upon claim 64 and are therefore allowable for at least the same reason.

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Respectfully submitted,

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Date: March 26, 2008

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